

THE DESIGN OF LEARNING MATERIALS TO DEVELOP SPATIAL THINKING FOR STUDENTS THROUGH GEOGRAPHY IN VIETNAM SCHOOL

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Abstract:

Spatial thinking is powerful and ubiquitous, underpinning everyday life, work, and science that plays a role in activities ranging from understanding geography and history. The standards for history and geography integrated teaching stress the importance of spatial thinking, which is essential for any further understanding of geographical meaning making. Perceiving the world from spatial perspective is a core geography competence which have just promulgated with the General Education Program, detailed in the description of students' competencies through Geography subjects. To form and develop this vital competence for students, it is important that they must be study with materials and activities so that create opportunities to foster their spatial thinking skills. Despite such an important role, the fact is that teachers when designing and using learning materials have not really focused on this requirement. The article focuses on instructional design in learning materials with spatial thinking approach as well as using suggestions.

Keywords: Spatial thinking, Design of learning materials, Geography

INTRODUCTION

Spatial thinking is common and vital in a various academic disciplines and everyday problem-solving situations. Study on "spatial thinking" has been carried out by multidisciplinary scientists, in which geography and education are strong areas in this regard (Jongon Lee and Robert Bednarz). The concept of "spatial thinking" was proposed and developed, until 2006, it was officially promoted in the Committee on Support for Thinking Spatially: "spatial thinking uses representations to help us remember, understand, reason, and communicate about the properties of and relations between objects represented in space", which comprise knowledge about three contents of space, inclusive of natural distinction, the exhibiting information methods, and the spatial

interpretation progress (Committee, 2006, p. 27).

LITERATURE REVIEW

In addition, spatial thinking is explicit by the National Research Council Report, including "the knowledge, skills, and habits of mind to use concepts, space, tools of representation like maps or graphs, and processes of reasoning to organize and solve problems" (Bednarz 2009). On the other hand, geography discipline is characterized by research on the differentiation spatial of objects on the earth. This strength has advantages in spatial thinking training for students and guide practice its curriculum. In Geography, the main competence of students in solving the problem of geography is that students can think of spatially (Armin Subhani).

Spatial thinking that obtained from geography articulate to assert that geography teaching and guide skill practice need to implement at all levels of instruction.

In Vietnam, the education has undergone a strong innovation, starting from general education with a clear orientation on quality and competency development requirements since 2018. In the geography curriculum outcomes of secondary school (from grade 6 to grade 9), spatial thinking is required competencies of Geoscientific awareness, Explore Geography and application knowledge that related to spatial thinking Ministry of Education and Training of Vietnam, Circular No. 32). It has also been allocated to textbook lessons. In addition, in the new Circular, the competencies of teachers about compile learning materials and organize activities are expected (Ministry of Education and Training of Vietnam, Circular No. 32). On the other hand, the teachers are the key factor leading to the success this curriculum reforms (Tjark Huizinga). In practical, if teachers do not participate in curriculum design, the implementation will face many difficulties (McKinney and Westbury 1975, Stenhouse 1975). Therefore, teachers need to have the ability to exploit documents, design lessons, organize the teaching process about spatial thinking to effectively deploy the program. However, in practice, teachers at the lower secondary level in Vietnam are rarely involved in the curriculum development process. The implementation of the teaching program is being implemented "up to down" approach, meanwhile, the requirement of changes in the new program, teachers must design learning activities based on the requirements to be achieved in the program, even without textbooks. In addition, the requirement for spatial thinking in geography has not been clarified in the curriculum framework. This leads to a lack of synchronization in the development of spatial thinking for students and limit of orientation for teachers. Although the Ministry of Education and Training has organized many training sessions to implement the new program, it has not focused on exploiting and documenting skills, especially on developing spatial thinking for students. Although there have been some studies on the program, analyzing Geography textbooks according to the old program to propose some additional integrated contents, the new program

are lack of researchers. This study focuses on clarifying the gaps in the design and implementation of the content for developing spatial thinking in Geography in middle school in the new program. By method of analyzing program system, related spatial thinking content in geographical textbook and surveying 109 samples on junior high school teachers in 3 central provinces of Vietnam, the results show the unreasonableness of textbooks. faculty and teachers' performance. It is valuable information for improving the material and training teachers effectively.

Therefore, the teaching design needs to be as important as the capacity of teaching organization. The spatiality of participant-produced lesson plans was evaluated based on the degree to which the lesson plan addresses three components of spatial thinking in an explicit manner. Using the taxonomy of spatial thinking (Figure 1), each of the lesson objectives and assessment items was coded by: (1) classifying the concepts that the objective (or assessment item) required students to know (i.e., non-spatial, spatial primitives, simplespatial, complex-spatial concepts), (2) determining the nature of the tools of representation that the objective (or assessment item) asked students to use (i.e., non-use, use), and (3) classifying the cognitive processes that each objective (or assessment item) expected to address (i.e., input, processing, output level). [Injeong Jo & Sarah Witham Bednarz (2014)]

This requirement is also set for the process of improving training programs at universities with pedagogical training, integrating elements in the professional competency model of pedagogical students should become a priority in the field of pedagogy.

Spatial thinking—one form of thinking—is based on a constructive merger of three elements: concepts of space, tools of representation, and processes of reasoning. It is the concept of space that makes spatial thinking a distinctive form of thinking. By understanding the meaning of space, we can use its properties as a vehicle for structuring problems, for finding answers, and for expressing solutions in some relevant fields. Spatial thinking can be learned, and it can and should be taught at all levels in the education system.

It then provides more formal definitions of the constructs of space and spatial thinking and illustrates the relevance of spatial thinking for a wide range of disciplines, concepts, tasks, and settings [Liben, L. S. (2006)]. Spatial thinking is the process of perceiving, reflecting on features, relationships and solving problems of spatial object phenomena by performing analytical and synthetic thinking operations, establish spatial relationships, compare, and infer of the learners (National Research Council, 2006). And our goal must be to foster a generation of students (1) who have the habit of mind of thinking spatially, (2) who can practice spatial thinking in an informed way, and (3) who adopt a critical stance to spatial thinking. In order to achieve this goal, the question is how can cognitive developmental and educational theory be used to develop new versions of curriculum that are subjects appropriate in their design and to conduct the material teaching in their scope and sequence?

Geography subject belong to General Education Program is designed with a new look, showing the high integration by some topic teaching and some detail competencies that to be meet the requirements of the curriculum. Therefore, innovating teaching and learning in the direction of integrated teaching is an indispensable and mandatory requirement for teachers. According to History and Geography, course will show three levels of content integration: Internal subject integration in each content of History and Geography education; Integrating interdisciplinary, integrating. At the secondary level, integrated teaching is reflected in learning topics. Teaching topics and topics such as the design of the course program not only show the principles of integrated program design but also pose the problem of integrated teaching organization in the practice of implementing the program. program, including the ability to design and implement teaching of teachers. In the description of specific competencies to be achieved in the program, the spatial perception of the world is described in detail the requirements to be achieved. Therefore, the design of teaching materials and teaching organization to ensure opportunities for students to develop spatial awareness play a vital role in the process of teaching the integrated topic of the subject.

METHODOLOGY RESEARCH

Methods of analysis and synthesis of theories: This method is used to analyze and synthesize domestic and foreign documents on the following issues: developing students' thinking in teaching, spatial thinking and developing spatial thinking in teaching Geography and History. Materials are collected, selected, analyzed, and synthesized in a comprehensive and scientific manner as a basis for research problems. The collective data in this paper was analyzed data from 05 textbooks includes: 03 sets of History and Geography textbooks for grade 6 of Vietnam and 02 foreign textbooks of History and Geography. On the basis of analyzing the characteristics, structure, presentation of content and learning tasks related to the development of spatial thinking for students in order to make appropriate inheritance recommendations. Data from the analysis of scientific articles published by previous and international authors are also the basis for carrying out our theoretical research.

Survey method: This method aims to collect information about the current situation and need for support for teaching and developing spatial thinking, reflected in teaching materials and using them. The survey was conducted using a questionnaire with both scale and multiple choice questions, open-ended questions with 109 teachers of History and Geography in the provinces of Thanh Hoa, Nghe An, Ha Tinh and other provinces.

Model of design: The development model employed in the present study refers to the procedural model by Dick and Carey (2001), with stage; (1) analyzing the needs and goals, (2) analysis the learning process, (3) analyzing the learners and context, (4) formulating learning objectives performance, (5) developing instruments, (6) developing learning strategies, (7) choosing and developing learning materials, (8) designing and implementing formative evaluation, (9) revising, (10) evaluating summative. For the purpose of the development of this research, the researcher only used up to step 9, which is revising the final product. The purpose of developers in this study is to produce teaching material which is valid and connected to spatial thinking. In particular, this study is adjusted to the learning objectives which want to be achieved, which is the understanding of

spatial concept of hydrology course of geography teacher in Vietnamese junior school.

RESULTS AND DISCUSSION

1. The relationship between teaching material and spatial thinking development

Learning materials are a collection of information sources that are processed and presented according to the idea of organizational structure, presentation form of teachers and students in the teaching process. In the case of learning materials designed by teachers such as worksheets, hand-outs, worksheets/orientation/manipulation instructions, simulation models, etc., for students to use as tools to support the process of knowledge discovery and skill training. If students design, then learning materials are forms of learning products that demonstrate the ability to process information, present information and other requirements set by the learning task. In both cases, teaching materials are created by teachers and students themselves in the teaching and learning process in order to convey the learning content, demonstrate the skills and attitudes of the designer on a certain issue of the curriculum. Therefore, when using learning materials to carry out learning activities, teachers and students need to have certain design skills to create products that meet the purposes and requirements of teaching and learning activities.

The curriculum of Geography at Secondary School (2018) is an integrated program that shows most clearly in the integrated topics. The main contents of the two fields is also designed in parallel, complementary and illuminate each

other. Therefore, in the teaching process, teachers and students both need to develop integrated teaching capacity. For teachers, due to the fact that most of them are trained by subject, the integrated teaching capacity still faces initial difficulties. For students, space-time thinking when learning subject matter should be given opportunities to develop through learning tasks and learning support tools. Design learning materials (designed by teachers) Teachers will actively express integrated ideas that the program has not shown clearly and may not be met by the textbook. For students, when assigned the task of designing learning materials, students must learn knowledge about the topic using, process information of two subjects, use tools (image channels, letters, models, etc.) pictures, figures, videos...) to present information, students are empowered to actively integrate learning.

Learning materials are not only contain contents but also promote students' thinking development which can be express in clearly. One of the main learning materials is textbook that we focus on this study to be made the comparison the ways expression spatial issues. In designing textbook, there were taken into account the newest informational standards and were used reference books, information from the internet, coloured maps, photos, and schemes. This textbook was revised by renowned geographers, experienced teachers, and educators. For issuing this textbook, there contributed the members of the Board who deal with authors of geography and economics textbooks, cartographers, and photographers. In Vietnam, according to the History and Geography Curriculum, the Cognitive competence from a spatial perspective is described as follows:

Table 1. Detail Cognitive competence from a spatial perspective []

Competence	Components	Detail discription
Geoscientific awareness	Spatial Orientation	Know how to use different means, especially the area to determine the exact direction; Know the geographical position of a place and the direction on a map; Know how to analyze the scope and scale of a territory.
	Geolocation analysis	Know how to analyze the influence of geography on natural and socio-economic processes.

	Distribution analysis	Describe the distribution characteristics of objects and geographical phenomena.
	Expressing spatial awareness	Use mental map to describe spatial perception; Use mental map to describe spatial relationships between geographical phenomena and things; Describe a locality with characteristic signs of nature, population and economy; Form an idea of the identity of a locality; Distinguish one place/local from another.
Explore Geography	Using the tools of geography	Study documents: finding geographic content in a paragraph; know how to title, caption a photo, painting from a geographical perspective; Using map in learning
Historical perception and thinking	Historical perception	Describe and initially present the main features of basic historical events with the main elements of time, place, happenings and results; evolution of battles and wars on the map, historical map. Analyze the effects of space and time context on historical events and historical figures

In this article, we use this description to compare with the textbook version, analyze and give suggestions for teachers in designing and using supplementary teaching materials. Additions, we give examples the ways to add spatial items some teaching materials.

When studying the print learning materials, we found that spatial thinking is expressed as follows: (1) Using written descriptions of territorial features; (2) Using maps, diagrams to show spatial relationships of phenomena, events, historical and geographical processes; (3) Using pictures with notes about the place; and (4) Using spatial analysis questions and exercises. We conduct an analysis based on these expression factors, the finding results show that spatial thinking is focused on presented in Vietnamese History and Geography textbooks (grade 6) with some outstanding characteristics.

Firstly, the system of maps appears frequency in both History and Geography branches with related questions and requirements, thereby enhancing students' self-study activities. Map design ideas with direction to spatial thinking steps: read the name of the map to identify the

objects, territories, content that the map represents; read the glossary to understand how the features on the map are represented; observe the objects according to the requirements of exploitation to recognize, identify, state the characteristics of each object, and finally observe the surrounding objects to find out the relationship between different objects. The ability to perceive the world from a spatial perspective is formed as a basis when students complete chapter 1, and continues to be developed and reinforced in all lessons in the following chapters. In Geography 6 there are many maps, diagrams, with many cognitive questions What? Where? How? that students find answers when reading and exploiting information from maps and diagrams. In most cases, students not only exploit one diagram in the lesson they are studying but also effectuate in the "Practice and Application" parts. Many tasks require students to read and compare two versions of the diagram "Different diagrams to explain the relationship between two phenomena" or "to answer the question Why?" that is interesting question, always stimulates the curiosity and curiosity of students, for example: Read and compare two diagrams using two different map projections to come to a

conclusion which projection is more accurate when representing the entire Earth's surface on the map. In particular, the History section uses a lot of maps to establish the spatial relationship of events, characters, and historical contexts, for example, when learning about human origins, students are given tasks to do. service on the map of vestiges of ancient people in Southeast Asia.

Secondly, the system of spatial pictures is especially focused in the space of the picture or the titles and notes which attached to the picture, for example the picture "Panoramic view of the Babylonian ruins of ancient Mesopotamia, Iraq". With such a design, an image is not only an external image of a geographical object or phenomenon, but also contains the internal content of the object, concepts, cause-and-effect relationships, and local laws. reason. Using images is also considered as a "fulcrum" for students' activities to improve students' thinking ability, especially analytical thinking and spatial thinking.

Thirdly, the system of descriptive paragraphs accompanied by pictures, map, diagrams, combined with the learning tasks in the textbooks, has created very favorable conditions for the formation and development of spatial thinking for students. In particular, questions of exploiting knowledge to develop spatial relationships such as What, Where, How have been utilized to the fullest in book design. Moreover, the suggested extension and application exercises play a very important role in organizing teaching for teachers and students.

However, the indicators of spatial thinking in textbooks are not clear that may be affect the process of exploiting strengths in design to develop spatial thinking for students. Therefore, in the process of teaching, teachers need to add some teaching materials to overcome this limitation.

2. Some instructions for design teaching material with spatial thinking relevant

Choosing a pedagogical design model: In this study, we selected the Dick and Carey pedagogical design model, focusing on developing pedagogical strategies, developing and selecting materials in the steps of connecting and binding each other to help teachers define teaching. what and how to teach.

The process of designing learning materials is carried out through the proposed following stages:

Stage 1: Analyze the structure of the lesson/topic content to determine the structure and requirements of the learning experience.

Stage 2: Searching for design materials

Stage 3: Design the corresponding visual experience

Stage 4: Organize learning materials and standard format

Stage 5: Using teaching materials, checking the level of support for thinking development and improvement

Making connection with map skill by map handbook: In terms of material form, it is necessary to ensure the visual and attractiveness of the design/presentation effects by handbook that can be deliver to students or other teachers. In which, content to avoid duplication such as structure such as textbooks or available references, the level of detail/generalization of the content should be ensured appropriateness. If the content is too detailed, it will make the teaching theory lengthy and overloaded; if it is too general, it will make the teaching theory monotonous/simple compared to the requirements to be achieved or the basic content of the topic/lesson as required by the chapter. subject program.

Material with comics: Comics produced by learners offer unique opportunities for the reflection and assessment of their ways of spatial thinking (Frederik von Reumont, Alexandra Budke, 2021) Teacher can design the comic that contain space or direction of objects relation, such as the lost way in forest, story about Columbus discovery, etc., Spaces can be considered containers literally containing geographically relevant phenomena, objects, history event and process. When space is examined under this premise, we can describe contained objects as singular entities that are part of a physical-material world. This requires a description of the characteristics shaping the landscape that is as exact as possible, e.g., the landforms as processual results of natural forces, infrastructure and buildings as results of human action, etc., The points of view of individuals or social groups are not crucial, but the goal is a

factual presentation that should be as objective as possible. In the geography class, creating comics can lead to a rich discussion and reflection on thought processes which are usually hidden behind a wall of words.

Focus on designing cognitive tasks, multi-level development questions about spatial thinking: to implement questions that include higher order thinking skills, adding the requisite for the students to perform at an extended level. Furthermore, the same fact might suggest to geography and history teachers to integrate challenging questions of promoting high-level cognitive processes. This kind of questions challenges students to deal with a hypothesis and go beyond the available information in the textbook, for sample "What would happen if the..." or "Let's make connecting with your local in...".

CONCLUSION

Spatial thinking is one of the specific competencies that not only plays an important role in teaching Geography, but also demonstrates the capacity for historical awareness, demonstrating the requirements of integrated teaching in History and Geography subjects. During the implementation of the General Education Program which promulgated, teachers and students have the opportunity to take initiative to develop their own capacity. In addition to exploiting available materials such as textbooks and reference books, self-designing teaching materials is one of the approaches for teachers to promote endogenous motivation in developing teaching capacity. At the same time, through designing, guiding students to design can create opportunities for learners to develop their competencies and qualities to meet the requirements of the 2018 General Education Program. To what extent the use of teaching materials ensures the requirements to be achieved in teaching, depending on the right of initiative, in accordance with specific conditions and contexts. The results obtained regarding needs are considerably higher and they reflect not only the willingness of the teaching staff to improve their works, but also their awareness of the changes and requirements entailed by teaching materials. Based on the discussion of the result, it can be concluded that spatial thinking can be included well into the teaching

materials developed and also can be assessed very good in encouraging spatial thinking in Geography subject. In the future, this study will be enhanced by involving both components, and components which positively gives influence on spatial thinking in integrated teaching and learning, and the effectiveness if all components included in teaching materials.

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